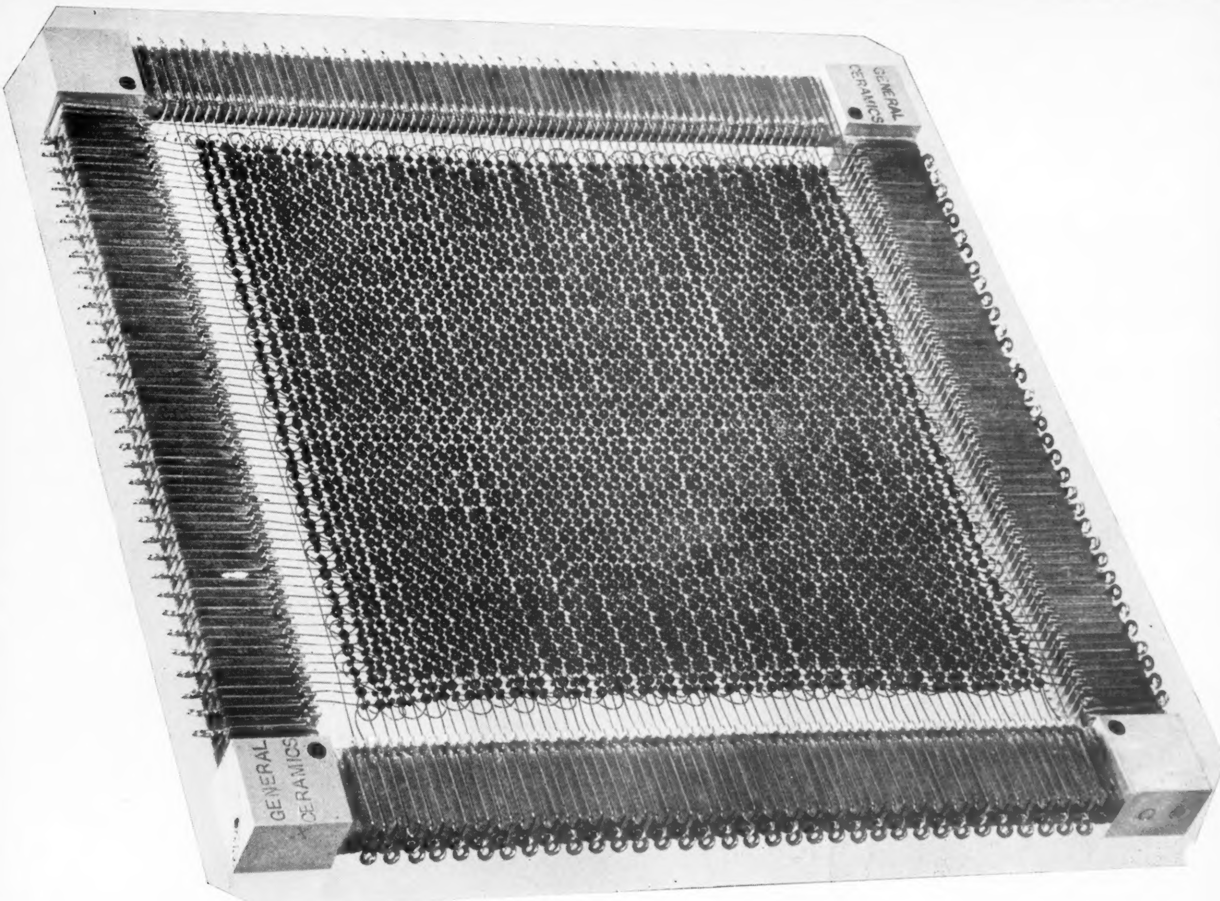
COMPUTERS
and AUTOMATION

DATA PROCESSING • CYBERNETICS • ROBOTS



JANUARY
1958
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VOL. 7 - NO. 1

Inertial Navigation

A PICTORIAL MANUAL ON COMPUTERS - Part 2

COMPUTERS

and AUTOMATION

DATA PROCESSING • CYBERNETICS • ROBOTS

Volume 7
Number 1

JANUARY 1958

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INERTIAL NAVIGATION

E. F. von Arx and Ken Brigham

Sperry Gyroscope Co., Division of Sperry Rand
Great Neck, New York

I. By E. F. von Arx

SOME MONTHS AGO, Sperry Gyroscope Company revealed that it was actually manufacturing new extremely accurate components for navigation using inertial principles in long range missiles, atomic ships, atomic submarines, and supersonic aircraft of both manned and pilotless types. In a voluntary move, anticipating military needs, the company had completely redesigned extensive plant areas and methods — and created new supersensitive test devices — to assure accuracy of inertial "platforms," flight controls and automatic weapons.

Fabrication of extreme-precision "floated" gyroscopes on a production basis, with required accuracy and ruggedness, required several years' planning and effort to bring about this major manufacturing change.

Engineers working in the field of inertial navigation are coming very close to producing the proverbial "black box." Completely self-contained inertial navigators are being built and applied to manned aircraft and to missiles. With those devices, it is no longer necessary to observe the stars or to transmit or receive electromagnetic energy in order to know the latitude and longitude of a vehicle traveling over the earth. These advances have been made possible by combining a long-known physical principle, some new component developments, and the application of feedback control techniques.

Schuler Pendulum

The fundamental physical principle involved is one which was first suggested by Dr. M. Schuler, a German professor of applied mechanics. He pointed out that the point of suspension of a pendulum whose length was equal to the radius of the earth could be moved about without disturbing the pendulum bob. At first thought, this would seem to be an interesting but impractical piece of information since no such physical device is possible. However, it is the key to inertial navigation.

A system consisting of gyros and accelerometers mounted in a gimbal configuration with appropriate feedbacks can be made to represent such a pendulum practically. In such a system, a platform is then established which maintains itself perpendicular to the local vertical and is not disturbed by motion of the carrying vehicle. An accelerometer mounted on such a platform can accumulate the basic data which will yield a continuous indication of present position.

Precise Components

It is very important that the elements which form such a system be very precise, since even small component errors will result in large system errors after a reasonable period of time. Therefore, the key to a successful inertial navigator is the component accuracy. In general, the minimum accuracy requirements are pressing on the state of the art for analog computation and therefore it seems that future systems will employ digital techniques. All component accuracies are important, but the most critical ones are: (1) Gyroscopes; (2) Accelerometers; (3) Integrators; and (4) Resolvers.

The most important characteristic required of gyroscopes for inertial navigation is low drift rate and high torquer linearity. The most widely used technique to accomplish low drift rates is one wherein the gyroscope wheel assembly is hermetically sealed and the container is floated. The electromechanical design of the torquer is also receiving considerable attention. Random drift rates of small fractions of a degree per hour are being obtained.

An accelerometer must be very linear and be able to detect minute acceleration differences. Many new designs have and are being developed, some of which give pure acceleration outputs, velocity outputs, or displacement outputs. The design principles vary, but the most widely used are pendulum and gyroscopic principles. Linearity of a small fraction of a percent is being obtained and accelerations equivalent to a tilt of seconds of arc from the horizontal are practical.

Computation

Depending on the accelerometer used, one or more integrations may be required in the inertial navigator. The most widely used technique is a velocity servomechanism which depends for its accuracy on the tachometer that is used. Again, accuracy of a fraction of a per cent is required and is being obtained.

The basic information obtained in these systems must often be transferred from one coordinate system to another; these are plane triangle problems. Furthermore, navigation over the earth leads to spherical triangle problems. Both of these require resolvers for their solution. Many new developments in precision resolvers are required, and again accuracy of a fraction of a per cent has been achieved.

The system as a whole is a problem in feedback control design. The servomechanism techniques widely studied and brought to use during and since the last war have made possible the reduction to practice of Schuler's physical principle, using the newly developed components for which this theory helped define the need. While the systems in actual use do not measure up to the eventual needs of the ultimate inertial navigator, the problem has been defined, industry is at work, and the goal is within reach.

II. By Ken Brigham

Many of the future systems for automatic navigation on inertial principles rely on a basic "gyro platform" or "stable table," which serves as a fixed space reference, enabling other sensors and computors to provide automatic directional control over any course desired, to an exact destination anywhere on the earth.

Men at Sperry Gyroscope producing inertial navigation devices under dust-free conditions.

The key elements of the stable platform for long-range accuracy are special types and sizes of extreme-precision "floated" gyros — originally developed for all U.S. military services by the Instrumentation Laboratory at Massachusetts Institute of Technology, under the direction of Dr. Charles S. Draper.

Operating principles of some platform systems employing MIT floated gyros, for long range missiles, ships and aircraft, are well known to military scientists. But fabrication of these high-precision gyros on a production basis, with needed accuracy and ruggedness, required several years' planning and effort.

Dust-Free Manufacturing

Today, in glass-enclosed areas of certain Sperry Gyroscope Co. plants, workers measure with a 3-ton instrument mounted on seismic blocks below the ground, friction forces so infinitesimal that the weight of a gnat would spin the dial beyond its working scale.

In sealed rooms, as antiseptic as surgery in hospitals, carefully chosen workers are clad from head to toe in special nylon gowns, caps and boots. These uniforms prevent microscopic dust, lint from clothing, etc., from reaching ultra-sensitive elements of the gyros and "accelerometers" which these workers put together under 45-power microscopes. Even an invisible speck of dandruff on a critical bearing might cause an error of several miles at the end of a 5,000-mile inertially-guided voyage or flight.

No paper is allowed in these rooms — even blueprints are transferred to plastic sheets before admittance. No visitors are allowed inside, except in dust-proof costume. The only entrance is through an air-lock chamber, where each person is blown dust-free by a powerful air-blast before and after donning the required uniform. Smoking, or face powder, are equally tabu, as abrasive sources of microscopic error.

Critical portions of these purposely-dispersed inertial plant areas are scientifically controlled for temperature and humidity. Air is filtered to an exceptional degree — removing all dust particles larger than 0.3 micron, or 12 one-millionths of an inch. This screens out many bacterial organisms, even perceptible traces of volcanic ash and meteorite dust which the trade winds and jet streams carry to settle throughout the earth.

New Inertial Devices

With marine, air and surface armament craftsmen already trained to operate such ultra-precision devices, other new inertial devices are being produced — including entirely new types of rugged, high-accuracy accelerometers, another recent Sperry development. These minature, ultrasensitive devices are proving capable of covering the entire range of "g-loads" presently planned for aircraft and rockets. They may thus become primary devices for sensing motion on the flight path of various guided missiles.

[Please turn to page 10]

How to speed up a digital computer

New Ampex Digital Tape System quickens input and output

Ampex's new digital tape equipment is to computers as a super-super highway would be to 1958's new 300 horsepower automobiles. Computer arithmetic can move at electron speeds — but previous input/output rates have been like bumper-to-bumper traffic. Now the jam is broken.

60,000 six-bit characters per second is one of several transfer rates available on the new Ampex Digital Tape System. Depending on how you can accept the data, some Ampex rates are even faster, others are somewhat slower.

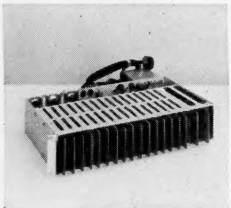
FR-300 Digital Tape Handler

To achieve a livelier pace . . .
a SYSTEM of new equipment

In a complete digital computer, the Ampex equipment provides two neatly packaged functions: input source and output receiver. By treating these as systems unto themselves, Ampex achieves optimum performance and reliability. In them, four interdependent items have been matched: tape handler, heads, amplifiers and magnetic tape. For the total result, the four are inseparable.

The Ampex FR-300 tape handler operates at 150 inches per second. With this new speed plus other format improvements contributed by the other Ampex components, transfer rates can be increased up to six fold over previous standards. Search times too can be reduced to one sixth.

The FR-300 starts or stops in 1.5 milliseconds. These times can be depended upon indefinitely. Hence they drastically reduce the buffer storage requirements of the computer system. Also, inter-record distances are accurate and are shortened by half.



Complete Electronic Assembly

Despite its race-horse gait, the FR-300 is a workhorse machine thoroughly tested and perfected in a year-long component shakedown. Its dependability and low maintenance requirements are aimed at increasing the computer's available working hours per day.

Two other Ampex tape handlers, the FR-400 and FR-200A operate at lower speeds, serving smaller computers and auxiliary digital equipment such as converters, printers, etc.

Read/write heads and amplifiers work together to achieve higher bit-packing densities. On the Ampex system, the 200-bit-per-second standard is conservative. Ampex's new heads can resolve pulses much closer than this. And the amplifiers easily handle the tremendous transfer rates achieved when closer bit packing and high tape speeds are combined. All-transistor design of the amplifiers achieves extreme reliability and compactness.

Ampex computer tape, a new specially formulated type, plays a key part in system reliability. To reduce *significant* dropouts and spurious noise to zero, the tape is manufactured in a completely air-conditioned plant. Employees wear lintless "surgical" clothing. And each reel is individually tested and packaged within two hermetically sealed wraps.

A tough new oxide binder on Ampex Computer Tape withstands many times the use of any previous "long wear" tapes. Virtually no oxide rubs off; heads need much less frequent cleaning. Precision reels, available as an option, protect the tape edges from damage and improve tape handling and guidance.

A newly published brochure is available describing all components of the Ampex Digital Tape System and explaining performance specifications. May we send you a copy?

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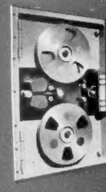
FIRST IN MAGNETIC TAPE INSTRUMENTATION
934 CHARTER STREET · REDWOOD CITY, CALIFORNIA

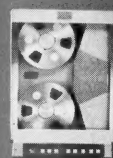
District offices serving all areas of the United States and Canada; Foreign Representatives in countries around the world.

MAGNETIC TAPE APPLICATIONS BY AMPEX

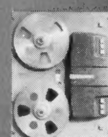
11
ONE OF A SERIES



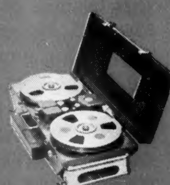
Series FR-100



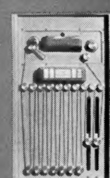
Model FR-400 Digital



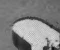
Model FR-200A Digital



Series 800 Mobile and Airborne



Series FL-100 Loop Recorders



Model MR-100 Missile Recorder

Readers' and Editor's Forum

A PICTORIAL MANUAL ON COMPUTERS, Part 2

In this issue we complete for the time being our report on the theme "Computers and Data Processing Presented in Pictures," of which Part 1 was published in the December issue. For the basis of selection of pictures and other comments, please see the December 1957 issue, page 7. Again, we should like to express our thanks to the organizations who kindly sent us pictures.

We hope to publish again a Pictorial Manual on computers in the December 1958 issue. In the meantime, if any reader has pictures of computers or components or allied equipment, pictures that explain or illustrate how something works or operates, pictures that do not have solely featureless concealing covers, we shall be eager to see them, and we hope we may be able to publish them, in the magazine or on our front cover. Some of the fine pictures that we found no room for in our report will also be published in early issues, in the magazine or on our front cover.

CURSE OR BLESSING?

I. From Mrs. P. Cammer, Huntington, N.Y.

I have no interest in computers and automation except insofar as they can better the human lot. It is my opinion that apart from noted achievements to that end, they are on the whole more of a curse to humanity than they are a blessing. I think it is an outrage to civilization for great minds — for all minds — to work on devices for A-bombs, H-bombs, and the tribe of idiot missiles and other weapons that are the foundation of modern economics.

II. Clipping she enclosed from the *New York Journal American*, Nov. 17, 1957:

Washington: — Administration will attempt to shave $600,000,000 from agriculture program funds for use in beefed-up missile development operations.

III. From *The Manchester Guardian*, Dec. 12, 1957

. . . when the fate of the first Vanguard rocket is considered, . . . no amount of preliminary testing can ensure that everything will work properly. . . . So it will be well if the Americans put off hunting for scapegoats until at least one other attempt at firing has been made. Unfortunately, however, the Vanguard rocket is not the only American rocket to have gone wrong. One I.C.B.M. after another has ended up in the sea or in flames on its launching platform. This sequence of events — but not the failure of a single Vanguard — suggests that there is something wrong with American engineering. In the ordinary run of American industry . . . it is acknowledged that the strength of the United States lies in the quality of its production engineering. It seems that the development of rockets — and atomic power too — is not attended by the same genius. . . . There is some evidence that the "crash programmes" of which the Americans are fond lead to a proliferation of complexities in engineering designs. . . .

It will be a pity if Americans conclude that a great deal more has blown up besides the rocket that was to have made of the United States satellite a fellow traveler with the original sputniks. Most of them already think that the sputniks' appearance (to say nothing of the Soviet intercontinental missile) has lost them "face." It would be unwise for them to plunge deeper into the sort of mood that regards all scientific endeavor as a race to be won or lost against a potential enemy. . . .

IV. From the Editor

Are computers and automation a curse or a blessing?

Are hydrogen bombs, atomic bombs, intercontinental ballistic missiles, and the rest of the tribe (with their computing brains), a curse or a blessing?

Is it desirable to shave $600,000,000 off the agriculture funds for a "crash programme" of missile development?

Is there something wrong with American engineering?

Have Americans lost "face" from the sputniks' appearance?

Are Americans going into a mood that regards all scientific endeavor as a race to be won or lost against a potential enemy?

What is the social responsibility of scientists for the scientific developments which they produce?

What should a magazine do about arguing these subjects, accepting a social responsibility about them, taking an editorial stand on them?

Hundreds of magazines in this country take the stand that they completely agree with the current underlying policies and assumptions of the U.S. Government except for minor details; or they completely omit discussion of "controversial" subjects, and concentrate on technical questions. Far be it from them to think in print about the human implications of hydrogen bombs guided by astute navigation devices making both the United States and Russia "deader than dead."

At least three magazines in the United States have accepted the concept of responsibility for the social effects of scientific, professional, or literary work. These magazines are *The New Yorker*, the *Saturday Review*, and the *Bulletin of the Atomic Scientists*. They stand out because they discuss controversial subjects; they publish unpopular views as well as popular ones. For example, there was a cartoon in *The New Yorker* recently, which as I remember showed a smiling middle-aged lady in an exhibition, standing in front of a U.S. State Department exhibit booth and inquiring cheerily, "Which are the dictator countries we are friends with?"

You who are reading this are a reader of COMPUTERS AND AUTOMATION. You have a vote. What do you

think about these burning questions? Would you write and tell us? or would you send us just a postcard with one word on it — either YES, let's discuss and argue the social responsibility of computer scientists; or NO, let's stick to the technical side, and leave the controversial subject of the social effects of computing devices to other people.

GREETING TO COMPUTERS (Solution)

In our December issue we published the following greeting:

For Christmas, we wish our subscribers, our readers, and all computer people:

```
            A
+     V E R Y          Y E A R
+ H A P P Y        + A H E A D
= P L E D P        = M O P D R
                              ID = YO
```

and 5741 2641 1280 320 52. (Solve for the digits; each letter stands for just one digit 0 to 9, although one digit may be represented by more than one letter.)

Solution: Change O to D. R plus D and no carry ends in R. Therefore D is zero. Twice A and no carry ends in D(zero). Therefore A is 5. A(5) plus one carried is M. Therefore M is 6. E plus P plus one carried ends in E. Therefore P is 9. Twice E plus one carried ends in P(9); therefore E is 4 or 9, but cannot be 9 since P is 9, and therefore is 4. H plus one carried is P(9); so H is 8. Y plus H(8) ends in D(zero); so Y is 2. R plus P(9) plus no carry ends in D(zero); so R is 1. Only 3 and 7 are unidentified; V plus A(5) ends in L; try V 3 and L 7; incorrect; therefore V is 7 and L is 3. Substituting in the numerical message we have:

AVER (Y,I)MER R(Y,I)H(D,O) L(Y,I)(D,O) AY and this clearly is A VERY MERRY HOLIDAY.

Inertial Navigation

[Continued from page 7]

Requirements to Be Met

The elaborate nature of the factory preparations to produce new inertial components, may be understood better in the light of the near-fantastic performance requirements. These "stable platforms" are expected to detect and automatically control angular deflections so small as to make the fabled Western sharpshooter's trick of hitting a silver dollar in mid-air seem like shooting fish in a barrel. Long-range missile guidance demands exact measurement of angles no larger than a dime over a mile away. To do this, sensing devices must be capable of detecting even finer movements — equivalent to the size of a football 100 miles away — or the area of a modern football stadium at the surface of the moon.

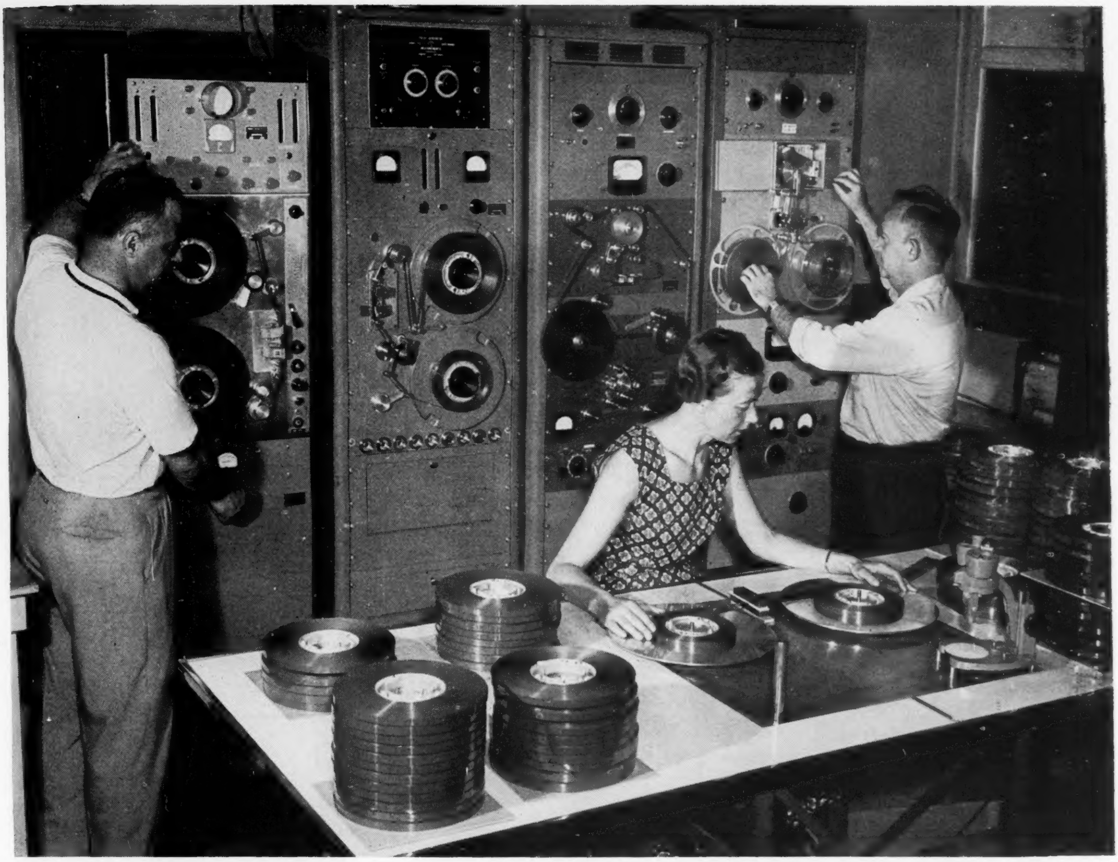
To maintain such accuracies through the extreme range of temperatures and shock of rocket vehicles, or through the long sea voyages of atomic ships and submarines, requires that the almost-perfect balance of critical sensing elements be maintained by a "dimensional stability," that is, held within a very small fraction of one wavelength of light.

A PICTORIAL MANUAL ON COMPUTERS, Part 2

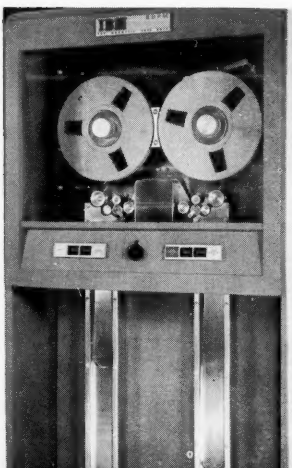
1. What Does "Magnetic Tape Memory" Look Like?

This single reel of magnetic tape holds as much information as ten of the file shelves. This reel of magnetic tape contains 2400 feet of magnetic tape and stores information at the rate of 125 characters to the inch. The scene is the Army Ordnance Tank-Automotive Command in Detroit, and the equipment is RCA's Bizmac. (Figure 1)

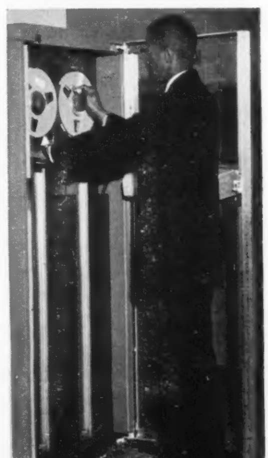
This file contains 50 lengths of magnetic tape, each 250 feet long; and it stores 20 million digits of information. This is the Datafile, part of the Datatron electronic computing system, made by the Electrodata Division of Burroughs Corp., Pasadena, Calif. (Figure 2)



Here, a battery of automatic machines at Audio Devices, Inc., N.Y., makes 100% inspection of magnetic tape intended for use on computers, data processors, instrumentation recorders, etc. Several million pulses are recorded on each reel of tape; if even a single pulse fails to reproduce properly for a tape under test, the machine automatically stops and signals the operator, and the reel is rejected for computer use. (Figure 3)

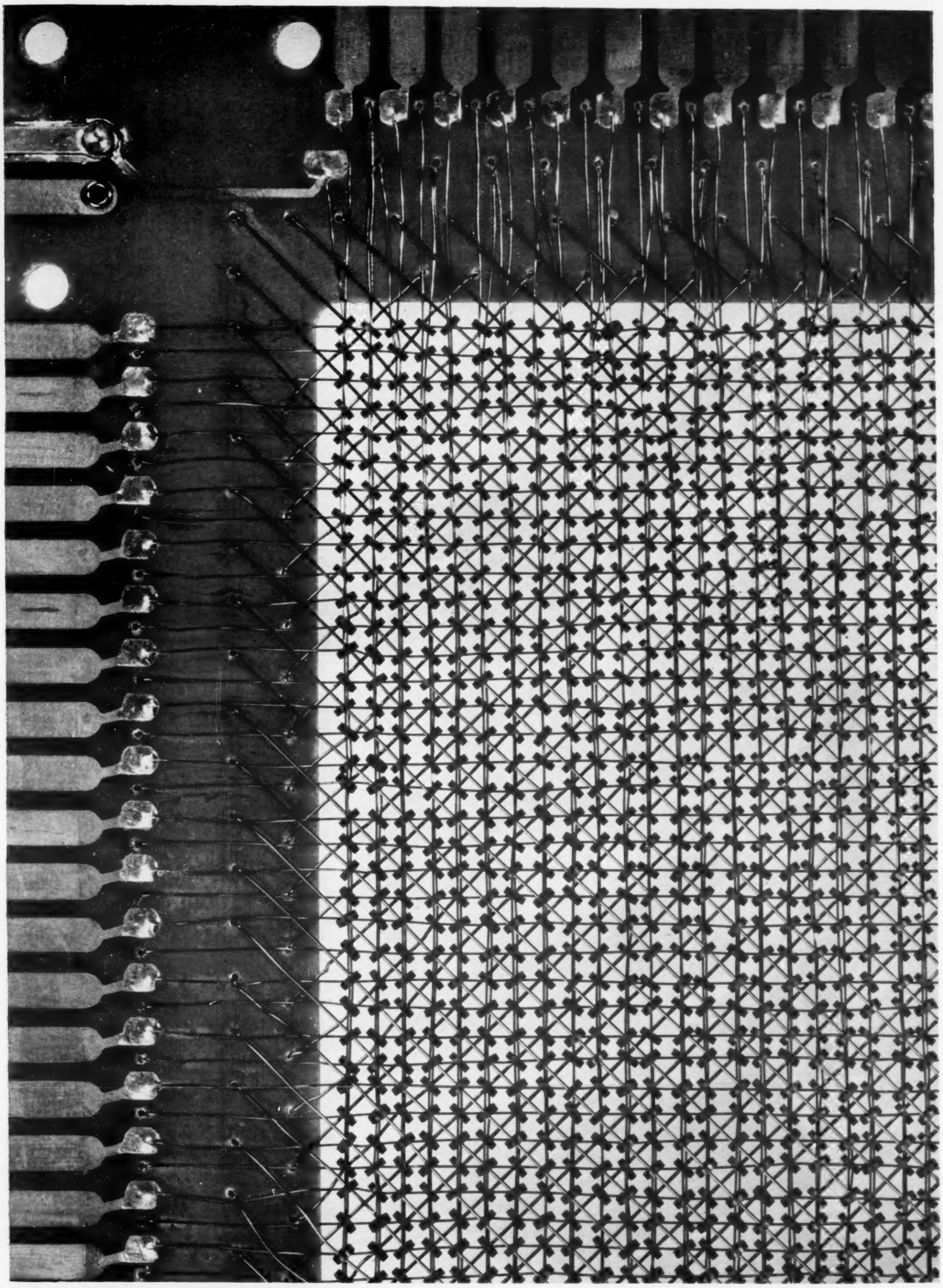


Here are two views of a magnetic tape input-output unit. The tape is cellulose acetate coated with magnetic oxide, and stores 200 characters per inch, so that a single reel of 2400 feet holds over 5 million characters. At left (Figure 4) we look right into the case and see the two loops of tape at the bottom; their length guides the controls. At the right (Figure 5) Richard Blue of Bell Aircraft Corp., Buffalo, N.Y., is changing a reel. The machine is International Business Machines' Type 727.

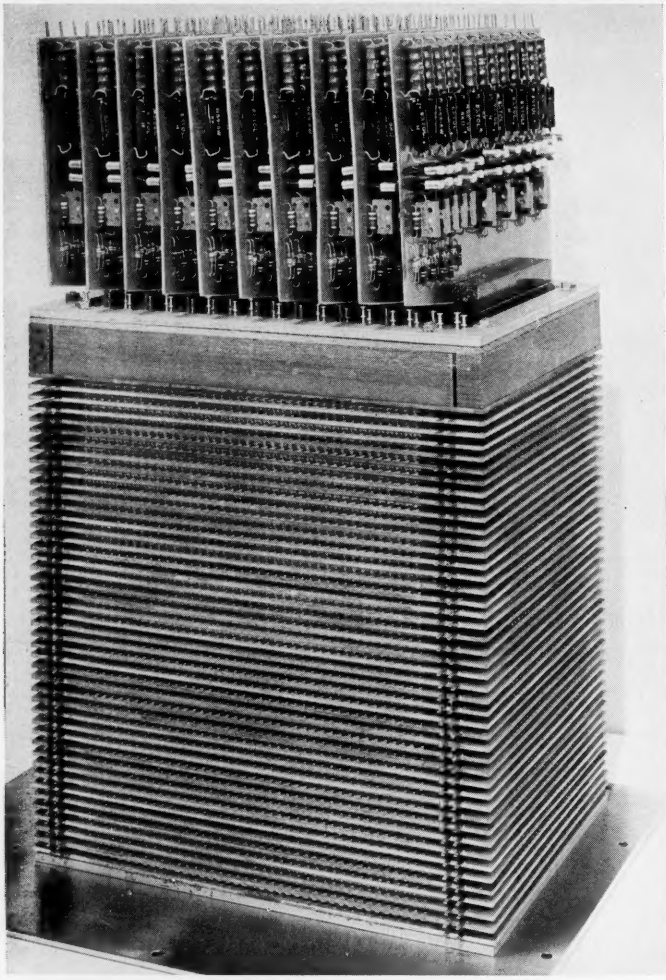


This device handles magnetic tape, recording data on the tape or reading it back. It starts and stops in 3 to 5 thousandths of a second, can travel as fast as 75 inches per second, and accepts a width of tape up to 1½ inches. It is the Model 905 Digital Magnetic Tape Handler made by Potter Instrument Co., Plainview, L.I., N.Y. (Figure 6)

2. What Does "Magnetic Core Memory Look Like?"

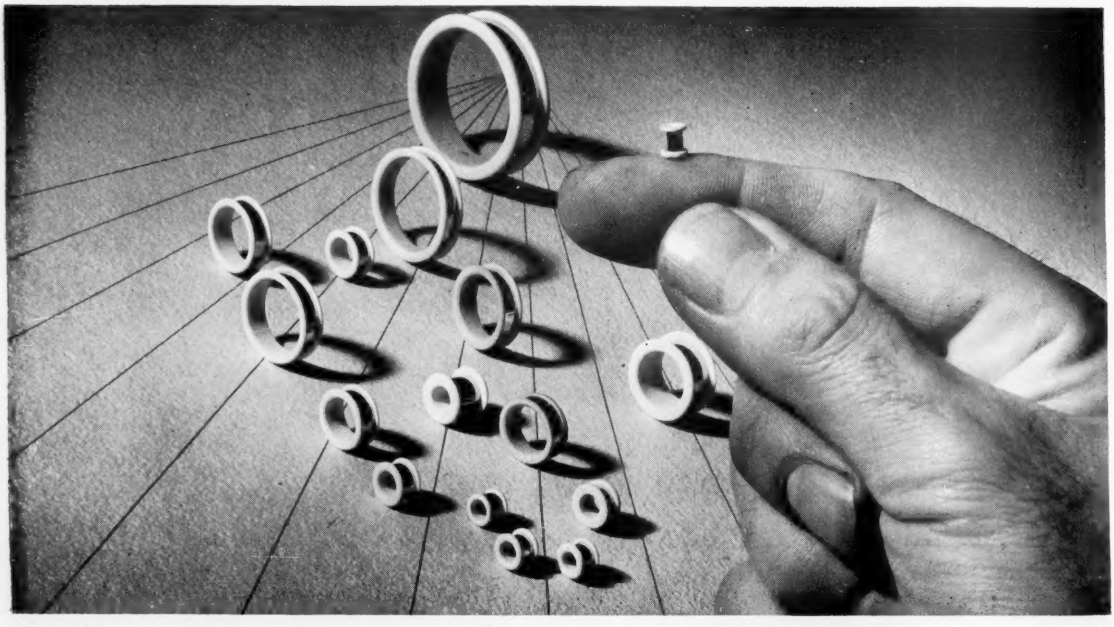


Here is a network of wires strung with tiny beads (magnetic cores shaped like doughnut rings) not much larger than the head of a pin. Each bead is made of a magnetic ceramic called a ferrite, and stores one binary digit of information, a "one" if the core is polarized in one direction, a "zero" if it is polarized in the other direction. This is an enlarged picture of a part of a corner of one of the core memory planes of the Univac II, made by Remington Rand Univac, Division of Sperry Rand. (Figure 7)

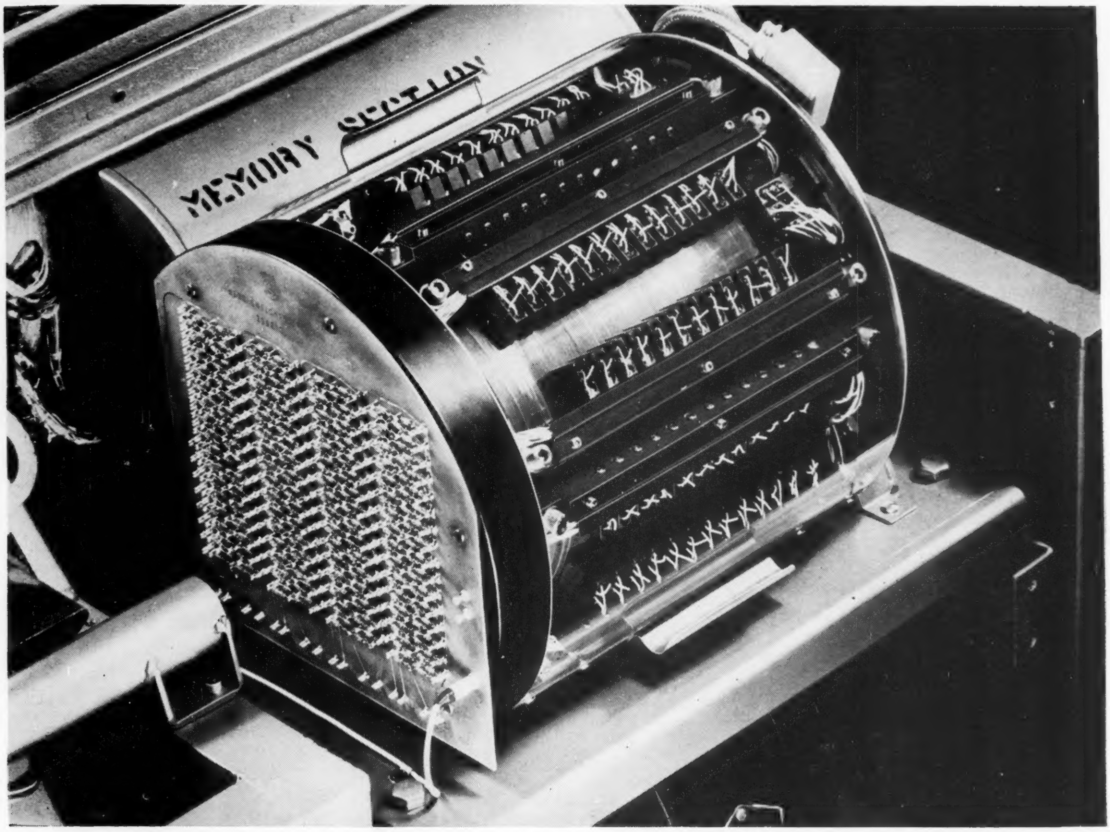


At left is a unit of the core memory stack of the Univac II, of Remington Rand Univac. It consists of about 44 core memory planes, and has a capacity of 24,000 characters. Any register in this memory will supply the information it holds within a few millionths of a second after the call for the information. (Figure 8)

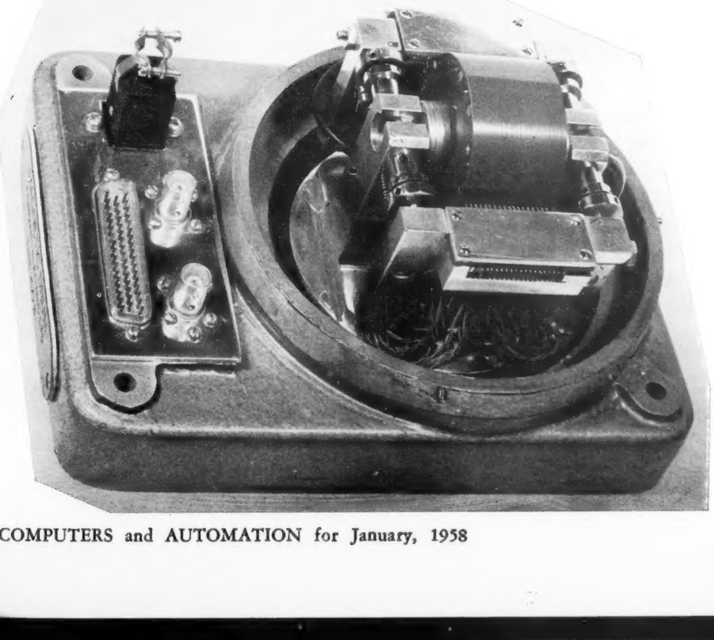
Below are computer magnetic cores of another type, ceramic bobbins wound with tape consisting of any one of several magnetic alloys (Deltamax, Square Permalloy, . . .). The tape is 1/1000 of an inch thick down to 1/8000 of an inch. These cores are made by Arnold Engineering Co., Marengo, Ill. (Figure 9)



3. What Does "Magnetic Drum Memory" Look Like?"



Above is a magnetic drum which is the memory for the Royal Precision LGP-30 Electronic Digital Computer. It stores 4096 machine words, each 32 binary digits long including the algebraic sign and the spacer mark. The computer is made by Librascope in California, and marketed by Royal McBee Corp. in New York, both of them subsidiaries of Royal Precision Corp. (Figure 10)



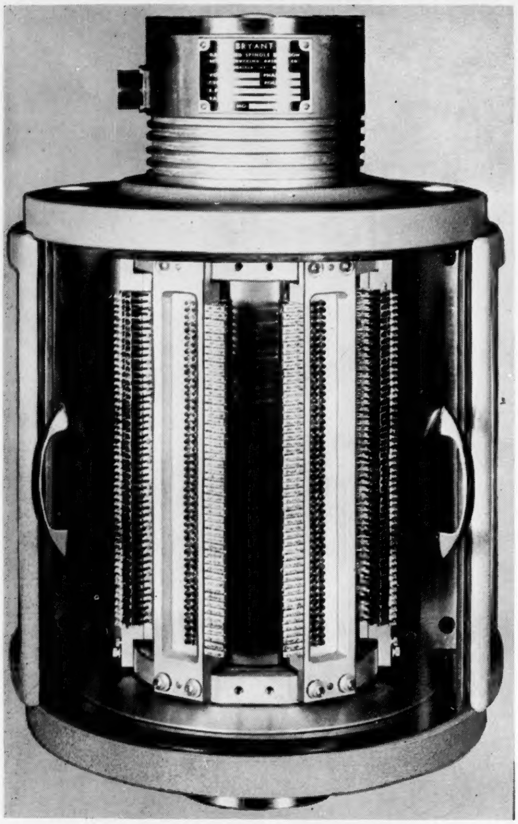
At the left is a very small magnetic drum with great capacity and very high speed, 22,500 revolutions per minute, which leads to fast access to any piece of information stored on the drum. This is the 200B High Speed Magnetic Storage Drum of Ferranti Electric Co., Hempstead, N.Y. (Figure 11)

ANNUAL INDEX TO COMPUTERS and AUTOMATION
Part 2

This index covers information published in the twelve issues of COMPUTERS and AUTOMATION, vol. 5, no. 12, Dec. 1956, to vol. 6, no. 11, Nov. 1957. The last part of each entry gives: volume/number (month of issue), page number.

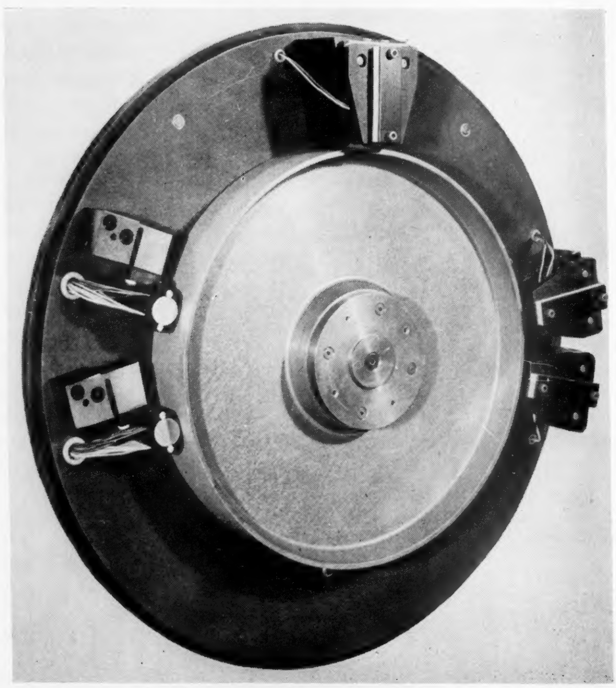
Part 1 of this index was published in the preceding issue, December, 1957.

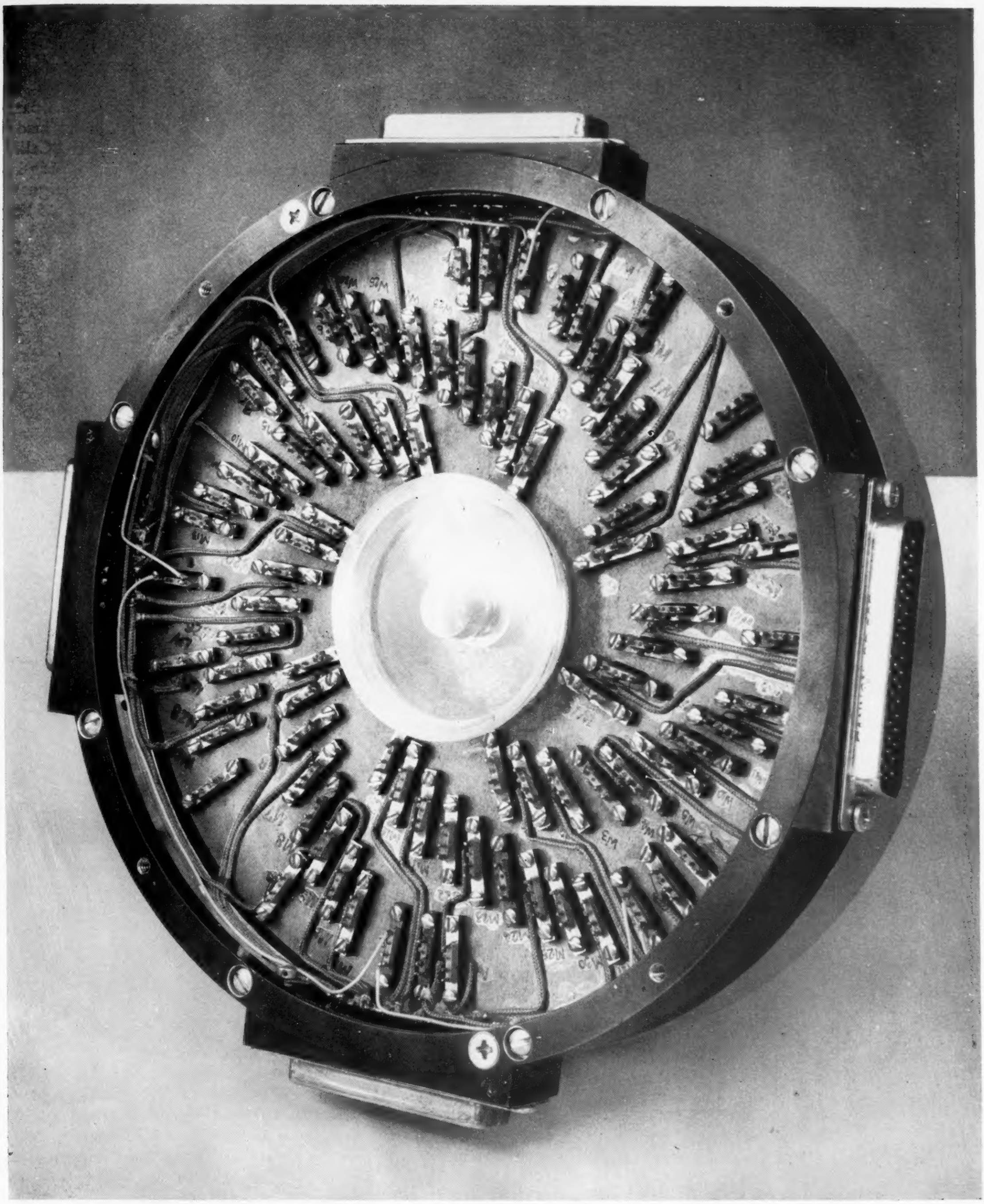
[Please turn to page 25]



This magnetic drum (at left) is 5 inches in diameter and 12 inches long; it can turn at speeds up to 12,000 revolutions per minute, permits 240 magnetic read/record heads, and can store as many as 625,000 binary digits of information. This is the Type 512A drum made by the Bryant Gage and Spindle Division, Springfield, Vt. (Figure 12)

The magnetic drum (at right) in a usual application can: provide 28 channels of storage; contain 2400 binary digits on each channel; store about 67,000 binary digits of information; turn at 3600 revolutions per minute. This is the Monrobot 28 drum made by the Electronics Division, Monroe Calculating Machine Co., Morris Plains, N.J. (Figure 13)

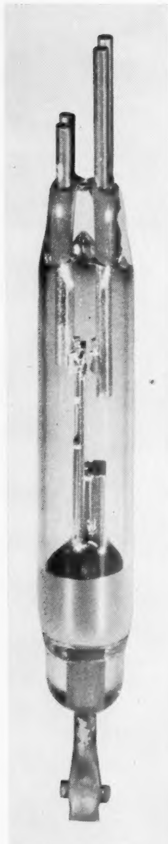




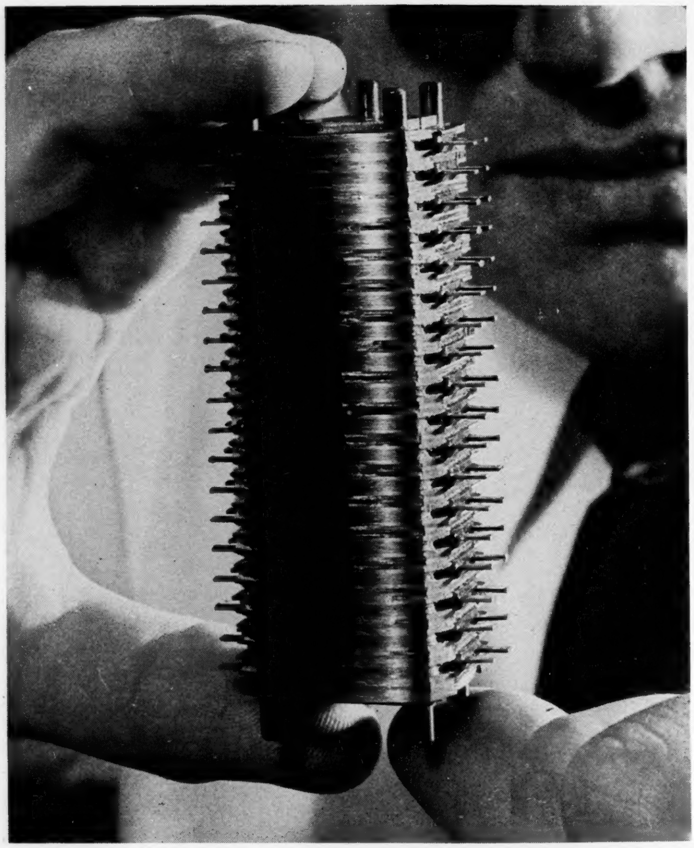
This is a magnetic disk memory for a digital computer. Eighty-eight separate magnetic heads are arranged over the disk, each one attending to a different track. The total diameter of the disk is eight inches. The density with which information is packed on this disk is stated to be "five times greater than the average rotating magnetic memory unit." This magnetic memory is used in the portable, general purpose, digital computer, RECOMP, made by Autonetics, Division of North American Aviation, Downey, Calif. (Figure 14)

4. What Do "Computer Components" Look Like?

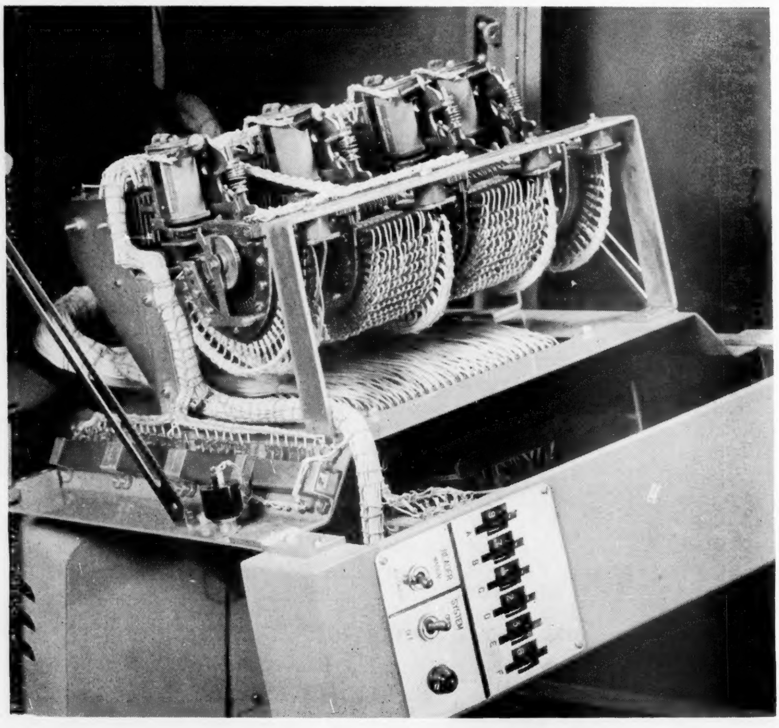
At left is a picture of components in part of the logical section of a computer made by Litton Industries, Beverly Hills, Calif. It shows wiring cables, sockets for plug-in circuit boards, nine relays (at the right), and other components. (Figure 15)



Above is the switching portion of a relay of an unusual type. The contacts have platinum surfaces, wetted all the time by mercury connected in a capillary way to a mercury reservoir, the whole being sealed in a glass capsule in an atmosphere of hydrogen at high pressure. The switch has a life of billions of operations, no "bounce" of contacts, and is extraordinarily stable. It is part of a mercury wetted contact relay made by C. P. Clare and Co., Chicago, Ill. (Figure 16)



At left is an assembly of 18 magnetic heads, for reading from or recording on magnetic tape three inches wide; the device will handle 60,000 decimal digits per second. This is part of the Datamatic 1000 Electronic Dataprocessing System, made by Datamatic Corp., Newton, Mass. (Figure 17)



At right is a bank of four stepping switches, in use in the Dataflo Programmer 275, made by Underwood Corp., New York. (Figure 18)

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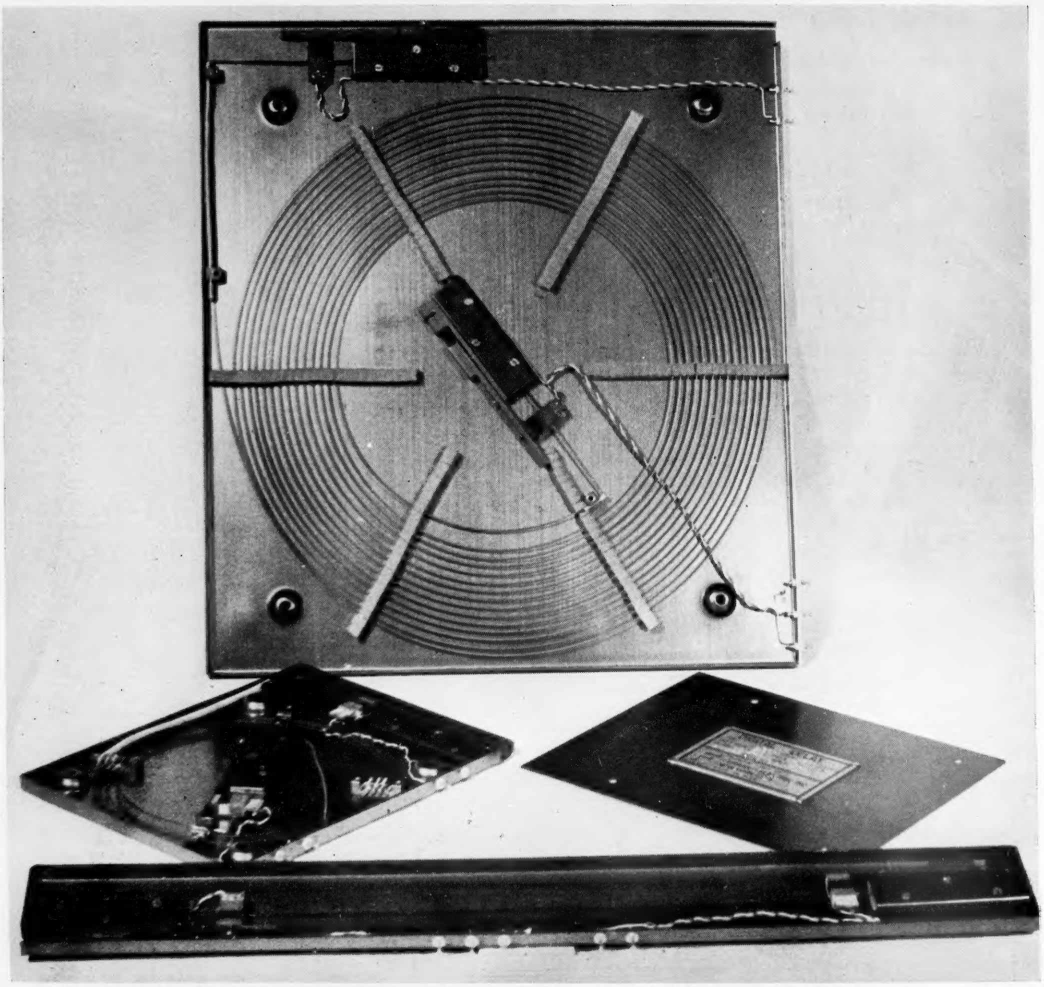
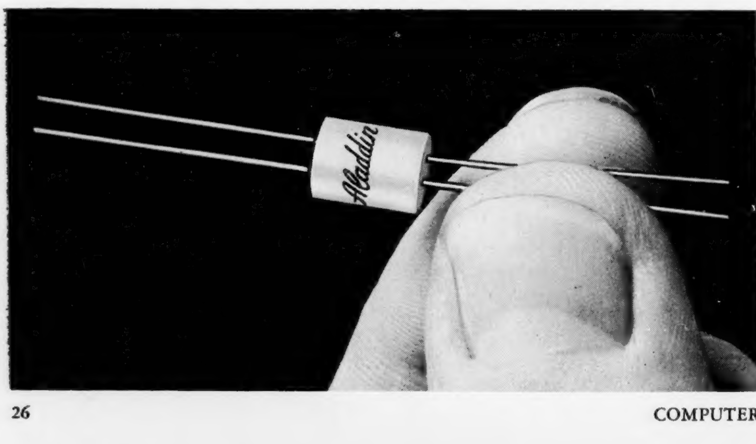
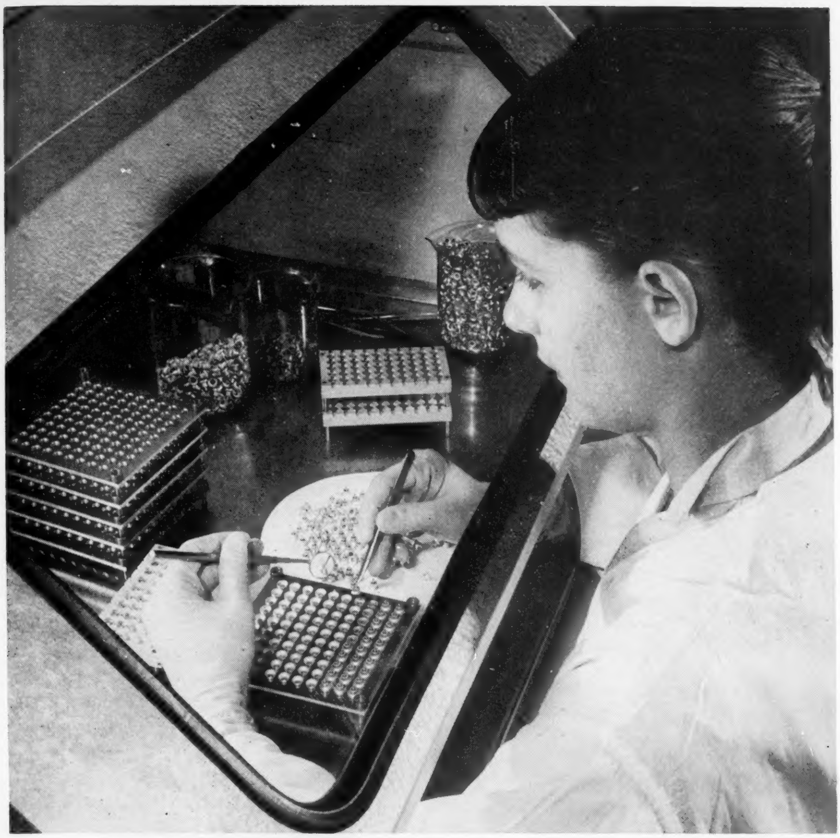


Here is a delay line of the magnetostriction type, stable under changing temperatures. Such a delay line will provide up to 1/200 of a second delay for separate pulses as fast as one million a second. It is made by Ferranti Electric, Inc., Hempstead, N.Y. (Figure 19)

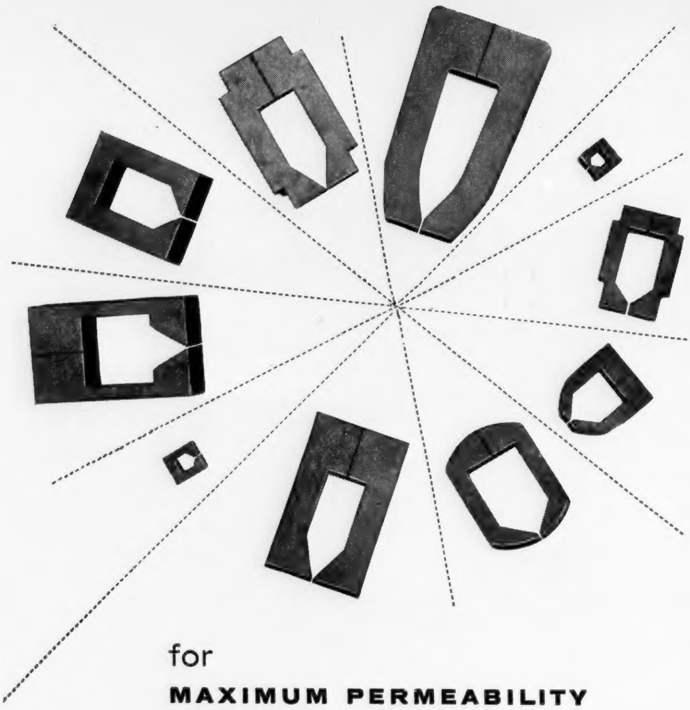


At left is a pulse transformer, .285 inches in diameter, and .350 inches long, held between thumb and forefinger. The core is ferrite; the two or more windings are made of size 48 wire. Many large-scale electronic data processing machines contain 1500 or more pulse transformers. This one is made by Aladdin Industries, Nashville, Tenn. (Figure 20)



(At left)
Here is the final process of assembly of some transistors under a hood that keeps out dust and moisture. Ruth Lewandowski is using a dental mirror to guide her, as she fits metal caps on rows of transistors. The place is the semiconductor manufacturing plant of Hughes Aircraft Co., Los Angeles. (Figure 21)

Below is the top of a sandwich of two cards with four surfaces of etched wiring, containing all the diodes for gating signals in the Royal Precision LGP-30 Electronic Computer. The board contains 680 diodes and is pluggable. The machine is built by Librascope, California, and is marketed by Royal McBee, New York. (Figure 22)



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INDUSTRY NEWS NOTES

ESSO CUBA REFINERY USES FISCHER & PORTER ANALOG COMPUTER-LOGGER

ESSO'S NEW catalytic-cracker refinery at Belot, Cuba features automatic data logging, coupled with a computer. The data logger, or log sheet printer, is conventional equipment in refinery operations, but the analog computer coupled with it, in a system made by Fischer & Porter, is considered by petroleum engineers to be a step along the road to computer control.

Data loggers have occasionally included some computing. But each item recorded on the loggers came generally from an individual measurement.

This system measures 101 process variables hourly in analog form, and makes them available in digital readout. It also feeds some of the measurements, reported in analog form, into an automatically programmed general purpose analog computer. This computer utilizes the basic information about process variables to solve 11 basic equations. The solutions are printed out in digital form as "true" or computed values, and serve as convenient operating guides in determining the efficiency of the process.

In many respects, such operating guides, according to Esso research engineers, are of more significance to the process operator than the measurable variables available. From a data logger, such guides can easily be computed, but they require time, and the aid of a technical observer.

The "operating guides" selected for automatic processing, for better control of the Belot cracking plant, are:

1. Carbon burning rate.
2. Catalyst circulation rate.
3. Catalyst-flow to oil-flow ratio.
4. Ratio of feed to reactor catalyst holdup. (How long the oil remains in contact with catalyst.)
5. 430 degree Fahrenheit vapor temperature conversion. (How much feed stock is being turned into gasoline.)
6. Percent weight of hydrogen in coke. (Measures oil lost with coke; indicates efficiency of stripping action.)
7. Percent weight of carbon made out of total feed. (Indicates fixed gases in relation to gasoline.)
8. Heat duty of top pump-around system. (Measures heat removal.)
9. Heat duty of mid pump-around system.
10. Regenerator superficial velocity. (Velocity of gas as measure of catalytic recovery.)
11. Reactor superficial velocity.

FRONT COVER: MAGNETIC CORE MEMORY PLANE

The front cover of this issue shows a computer component, a magnetic core memory plane. This is an array of 4096 small ferrite doughnuts, each of which can be magnetically polarized in either one of two directions, thus storing a one or a zero. Because these magnetic cores are supported by the bare wires which "write" in them and "read" from them, and the wires are pulled taut, the array becomes a plane. Each core is 25 mils thick, and has an inner diameter of 50 mils and an outer diameter of 80 mils. 820 milliamperes of current are sufficient to operate this memory. The cores and the memory plane are made by General Ceramics, Keasbey, N.J.

SYMPOSIUM: THINKING MACHINES OF THE FUTURE

Research Session on Information Processing
at the AIEE Winter Meeting
Thursday Afternoon, February 6, 1958
Hotel Statler, New York, N.Y.

The American Institute of Electrical Engineers has invited three speakers to explore the basic concept of information and the use of computers for conveying, digesting, and processing information so as to optimize certain controlled processes, or bypass human operations between the stage of concept and the stage of production.

The session will be addressed by Dr. J. B. Wiesner, Massachusetts Institute of Technology; Dr. Simon Ramo, Ramo-Wooldridge Corporation; and Dr. C. R. DeCarlo, International Business Machines Corporation.

The session is sponsored jointly by the Research Committee, the Computing Devices Committee, the Communication Theory Committee, and the Data Communication Committee of the AIEE.

IBM GROWTH

INTERNATIONAL BUSINESS MACHINES as of April 1957 had six million square feet of manufacturing, engineering, and educational facilities; new facilities under construction totaled 2.8 million square feet, all scheduled for completion by early 1958. New plants of the Data Processing Division have gone into production this year at Rochester, Minn.; San Jose, Calif.; and Burlington, Vt., so that the division now has five plants. The company's Time Equipment Division has announced the first IBM small-scale computer. Designed mainly for engineering applications, the new computer is expected to find a market in business as well. The bulk of IBM's defense work, in the Military Products Division, is in the computer field, consisting of the SAGE electronic air warning system, and the BRANE, a bombing and navigational system for installation in the B-52 Strato-fortress. IBM World Trade Corp. is tooling up for production of large-scale general purpose digital computers in France and Germany.

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NEW PATENTS

RAYMOND R. SKOLNICK, Reg. Patent Agent
Ford Inst. Co., Div. of Sperry Rand Corp.
Long Island City 1, New York

THE following is a compilation of patents pertaining to computers and associated equipment from the "Official Gazette of the United States Patent Office," dates of issue as indicated. Each entry consists of: patent number / inventor(s) / assignee / invention. Printed copies of patents may be obtained from the U.S. Commissioner of Patents, Washington 25, D.C., at a cost of 25 cents each.

Sept. 17, 1957: 2,806,353 / Louis N. Grafinger, Paramus, N.J., and Bernard J. O'Connor, Tuckahoe, N.Y. / Bendix Aviation Corp., Teterboro, N.J. / A mach number computer.

2,806,648 / Joseph D. Rutledge, Darling, Pa. / Sperry Rand Corp., New York, N.Y. / A half-adder for computing circuit.

2,806,950 / Robert Carbrey, Madison, N.J. / Bell Telephone Lab., Inc., New York, N.Y. / A circulating pulse decoder.

2,806,986 / Hans P. Luhn, Armond, N.Y. / I.B.M. Corp., New York, N.Y. / A high performance position servo system.

2,807,005 / James A. Weidenhammer, Poughkeepsie, N.Y. / I.B.M. Corp., New York, N.Y. / A device for converting and reinscribing magnetically recorded data.

2,807,015 / Robert J. Shank, Encino, Calif. / Hughes Aircraft Co., Del. / A range voltage generating circuit for automatic range tracking.

2,807,017 / Richard N. Close, Mineola, N.Y. / U.S.A. by Sec. of War / An aircraft borne radio computer system.

Sept. 24, 1957: 2,807,376 / Georges X. Lens, Antwerp, Belgium / International Standard Electric Corp., New York, N.Y. / A combined code recorder and selector.

2,807,413 / Edward J. Rabenda, Poughkeepsie, N.Y. / I.B.M. Corp., New York, N.Y. / An electronic decimal storage system.

2,807,414 / Louis A. Howard, U.S. Navy / I.B.M. Corp., New York, N.Y. / A machine for reading each card of an array of record cards each having a leading edge with columns of index points containing representations of data in the form of light transparent areas disposed parallel thereto.

2,807,415 / Robert I. Roth, Briarcliff Manor, N.Y. / I.B.M. Corp., New York, N.Y. / A record perforation analyzing means.

2,807,664 / Harry Kleinberg, Pensauken, and John S. Baer, Woodbury, N.J. / Radio Corp. of America, Del. / A system for recognizing information encoded in groups of binary-valued digital positions on a storage medium and for printing said information.

2,807,715 / Arnold Lesti, Nutley, N.J. / I.T.T. Corp., Maryland / A decoder for pulse code modulation systems.

2,807,716 / Floyd G. Steele, La Jolla, Calif. / Digital Control Systems, Inc., La Jolla, Calif. / A correlation of flip-flop and diode gating circuitry.

2,807,717 / Robert C. Paulsen, West Caldwell, N.J. / I.B.M. Corp., New York, N.Y. / A measuring and indicating system.

2,807,728 / Tom Kilburn, Manchester, Frederic C. Williams, Timperley, and Eric R. Laithwaite, Preston, Eng. / National Research Development Corp., London, Eng. / A digital data storage system.

Oct. 1, 1957: 2,808,202 / William C. Hahn, Scotia, N.Y. / General Electric Co., New York / A carry unit for binary digital computing devices.

2,808,203 / Bernard H. Geyer, Jr., Syracuse, and Curtis D. Cockburn, Baldwinsville, N.Y. / General Electric Co., New York / A binary system shifting register.

2,808,204 / Bernard H. Geyer, North Syracuse, and Charles R. Wayne, Syracuse, N.Y. / General Electric Co., New York / A binary digital computing apparatus.

2,808,205 / Francois H. Raymond, Le Vésinet, and Roger R. Dussine, Paris, Fr. / Societe d'Electronique et d'Automatisme, Courbevoie, Fr. / An electric adder-subtracter device.

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THE COMPUTER DIRECTORY AND BUYERS' GUIDE, 1958

is the June 1958 issue of

COMPUTERS AND AUTOMATION

Be sure to send your entries to:

Directory Editor

COMPUTERS AND AUTOMATION

815 Washington Street
Newtonville 60, Mass.

New Patents

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2,808,557 / John W. Smith, Cedar Rapids, Iowa / Collins Radio Company, Cedar Rapids, Iowa / A remote control servo-system.

October 8, 1957: 2,808,649 / Einard Nyyssonen, Watertown, Mass. / U.S.A. by Sec'y of the Air Force / A range computing apparatus for gynomonic maps.

2,808,983 / Albert M. Uttley, Great Malvern, Spencer W. Noble, Upper Colwall, and Ronald H. Carter, Malvern, Eng. / National Research Development Corp., London, Eng. / An electronic digital computing apparatus.

2,808,984 / Byron O. Marshall, Jr., Pittsburgh, Pa., and John D. Dillon, Melbourne, Fla. / — / A coding device.

2,808,985 / Clifford A. Shank, Redondo Beach, and Norman M. Brown, Jr., and Charles E. Ault, Los Angeles, Calif. / Garrett Corp., Los Angeles, Calif. / An angle of attack Computer.

2,808,986 / Joseph J. Stone, Jr., Clinton, Estle R. Mann, Oak Ridge, and Edward S. Bettis, Fountain City, Tenn. / U.S.A. by U.S. Atomic Energy Comm. / An electronic digital computer.

2,808,987 / Jack B. Speller, White Plains, and Frank S. Preston, Tarrytown, N.Y. / Norden-Ketay Corp., Ill. / An apparatus for generating trigonometric functions.

2,808,988 / Wilhelm Kafka, Tennenlohe-Turmberg, near Erlangen, Germany / Siemens-Schuckertwerke Aktiengesellschaft, Berlin-Siemensstadt and Erlangen, Germany / An electrical apparatus for forming products or quotients of physical magnitudes.

2,808,989 / James R. Younkin, Bartlesville, Okla. / Phillips Petroleum Co., Del. / A computer for solving simutaneous equations.

2,808,990 / Roland L. Van Allen, Alexandria, Va. / U.S.A. by Sec'y of the Navy / A polarity responsive voltage computing device.

2,809,367 / Raymond Stuart-Williams, Pacific Palisades, Calif. / Telemeter Magnetics and Electronics Corp., Los Angeles, Calif. / A magnetic core memory system.

2,809,369 / Thomas A. Feeney, Los Angeles, and Ralph D. Adams, Inglewood, Calif. / Coleman Engineering Co., Los Angeles, Calif. / An analog-to-digital converter.

ADVERTISING INDEX

Following is the index of advertisements. Each item contains: Name and address of the advertiser / page number where the advertisement appears / name of the agency if any.